

## Reporting radiosurgery plan indices must be accompanied by the derived method as some indices can vary significantly with technique used for the same definition -Case study, the High Dose Spillage as used in several RTOGs

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## Abstract

**Objectives:** Radiosurgery indices, useful in evaluating SRS/SRT/SBRT plan quality are derived from a treatment plan based on a given definition. However some derived indices may vary based on the method used even though the correct definition was applied. We illustrate this using the High Dose Spillage (HDS) that is required in several RTOG protocols, for example, RTOG 0813, and RTOG 0915.

**Methods:** We utilized clinically approved treatment plans of eight (n=8) previously treated lung SBRT patients. For each plan, we computed HDS, defined as the volume of tissue outside the PTV, expressed as a percentage of the PTV volume, irradiated by at least 105% of the prescribed dose (1.05Rx). We used 2 techniques (T1, T2) to compute HDS in each patient case;

**T1:**  $HDS = (\text{All Tissue Volume receiving at least } 1.05Rx) \text{ MINUS } (\text{PTV Volume receiving at least } 1.05Rx)$ . The External (or Body) contour is used for all tissue.

**T2:** First we used the treatment planning system (TPS) to derive a new contour, namely the external contour MINUS the PTV (External-MINUS-PTV), then  $HDS = \text{Volume of External-MINUS-PTV contour receiving at least } 1.05Rx$

The HDS as derived from T1 and T2 were then compared.

**Results:** The derived HDS as calculated from the 2 techniques was consistently different among all 8 cases. On average, we observed a  $90\% \pm 13\%$  (range, 65% to 100% discrepancy) between T1 and T2. Furthermore, depending on the method used in deriving the new contour in T2, the resulting HDS calculated was different. For example, when we used (a) deriving the new contour using margins, where the new contour is derived from the External contour with zero margin and using the PTV as an avoidance structure versus (b) using the Boolean functionality in the TPS where the new contour was derived by applying External sub PTV. We observed a

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21% discrepancy in calculating HDS between (a) versus (b) for one patient. We used Varian Eclipse TPS, version 11. The observed differences in HDS can be attributed to volume round-off errors which may not be significant with respect to the final derived volumes but does have an effect in the calculated HDS as shown.

For our clinical evaluations, we use ClearCheck (RadFormation Inc, NY) to compute the indices including HDS for our SBRT plans. The ClearCheck results are in agreement with those calculated in T1.

Conclusions: This work shows that important quality indices used in evaluating SRS/SRT/SBRT plans may be different depending on the method of derivation. Therefore when reporting or requesting these indices, it is important to clearly state how the indices are derived from the treatment plans, something which is currently lacking in current protocols including RTOGs.

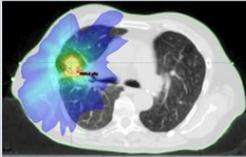
**Reporting radiosurgery plan indices must be accompanied by the derived method as some indices can vary significantly with technique used for the same definition - Case study, the High Dose Spillage as used in several RTOGs**

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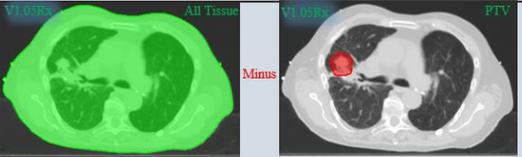
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**Purpose:** Radiosurgery indices, useful in evaluating SRS/SRT/SBRT plan quality are derived from a treatment plan based on a given definition. However some derived indices may vary based on the method used even though the correct definition was applied. We illustrate this using the High Dose Spillage (HDS) that is required in several RTOG protocols, for example, RTOG 0813, and RTOG 0915.

**Methods:** We utilized clinically approved treatment plans of eight (n=8) previously treated lung SBRT patients. For each plan, we computed HDS, defined as the volume of tissue outside the PTV, expressed as a percentage of the PTV volume, irradiated by at least 105% of the prescribed dose (1.05Rx). We used 2 techniques (T1, T2) to compute HDS in each patient case;



**T1: HDS = (All Tissue Volume receiving at least 1.05Rx) MINUS (PTV Volume receiving at least 1.05Rx). The External (or Body) contour is used for all tissue.**



**T2: First we used the treatment planning system (TPS) to derive a new contour, namely the external contour MINUS the PTV (External-MINUS-PTV), then HDS = Volume of External-MINUS-PTV contour receiving at least 1.05Rx. TPS used was Eclipse V11**

*The HDS per T1 and T2 were then compared.*

**Results:** The derived HDS as calculated from the 2 techniques was consistently different among all 8 cases. On average, we observed a 90% ± 13% (range, 65% to 98% discrepancy) between T1 and T2. Furthermore, depending on the method used in deriving the new contour in T2, the resulting HDS calculated could be different.

Patients (+)	High Dose Spillage via 2 methods T1/T2		
	T1	T2	% Diff
P1	0.763	0.019	97.51
P2	0.41	0.142	65.32
P3	4.14	0.101	97.55
P4	3.1	0.005	99.84
P5	2.55	0.171	93.30
P6	0.88	0.226	74.32
P7	2.5	0.007	99.72
P8	1.32	0.084	93.65

For our clinical evaluations, we use ClearCheck (RadFormation Inc, NY) to compute the indices including HDS for our SBRT plans. The ClearCheck results are in agreement with those calculated in T1. Table below is a ClearCheck eval for patient P1

**HUMC\_RTOG 0813 Lung SBRT-5fx Constraints**

Structure Plan	Type	Prescription	Constraint	Goal	RUL FB	Pass/Fail
PTV_RUL	Target		V5000Gy ≥	95%	95.058%	✓
PTV_RUL	Target		V4500Gy ≥	99%	100%	✓
PTV_RUL	Target	Default: 5000Gy	Max σ	111-160%	103.194%	⚠
PTV_RUL	Target	Default: 5000Gy	Dose Spill V105% ≥	15%	0.763%	✓
PTV_RUL	Target	Default: 5000Gy	C1 100% σ	1.2-1.5	0.966	✓
PTV_RUL	Target	Default: 5000Gy	C1 50% σ	4.418-5.418	4.029	✓

**Conclusion:** This work shows that important quality indices used in evaluating SRS/SRT/SBRT plans may be different depending on the method of derivation. Therefore when reporting or requesting these indices, it is important to clearly state how the indices are derived from the treatment plans, something which is currently lacking in current protocols including RTOGs.

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